Section 5
SHORELINE STABILISATION

5.1 Overview of Options

Options for handling beach erosion along the western segment of Shelley Beach include:

- ***Do Nothing*** – which implies letting nature take its course;
- ***Beach Nourishment*** – place or pump sand on the beach to restore a beach;
- ***Wave Dissipating Seawall*** – construct a wave dissipating seawall in front of or in lieu of the vertical wall so that wave energy is absorbed and complete protection is provided to the boatsheds and bathing boxes behind the wall for a 50 year planning period;
- ***Groyne*** – construct a groyne, somewhere to the east of Campbells Road to prevent sand from the western part of Shelley Beach being lost to the eastern part of Shelley Beach;
- ***Offshore Breakwater*** – construct a breakwater parallel to the shoreline and seaward of the existing jetties to dissipate wave energy before it reaches the beach; and
- ***Combinations of the above***.

5.2 Do Nothing

There is no reason to believe that the erosion process that has occurred over at least the last 50 years, at the western end of Shelley Beach, will diminish. If the water depth over the nearshore bank has deepened, as it appears visually from aerial photographs, the wave heights and erosive forces may in fact increase.

Therefore "Do Nothing" implies that erosion will continue, more structures will be threatened and ultimately damaged, and the timber vertical wall become undermined and fail, exposing the structures behind the wall to wave forces.

The cliffs behind the wall will be subjected to wave forces and will be undermined if they are not founded on solid rock. Ultimately the access path behind the timber wall that services the boat sheds will be undermined and lost.

The degree of erosion in the longer term will be determined by the structural integrity of the cliffs that lie behind the beach.

5.3 Beach Nourishment

Sand could be placed on the western portion of Shelley Beach to restore a beach such as might have existed when boat sheds first started to be built, that is restoring the beach to that which is depicted in the 1951 aerial photograph. The volume of sand required to create the beach is about 40,000 cubic metres.

However, the sand would not stay where it is placed. It would be moved by waves in an eastward direction and there may be some losses offshore. The rate of eastward movement may be greater than the historical rate of sand movement because the water depth off the beach is deeper than it was in 1951.

Movement offshore will depend on the size of sand placed on the beach. The sand on Shelley Beach has an average grain size of about 0.4mm. The offshore movement of sand for a severe, nominally 50 year return period storm is depicted in Figure 5.1 for three different sand sizes:- 0.4mm, 0.5mm and 0.8mm.

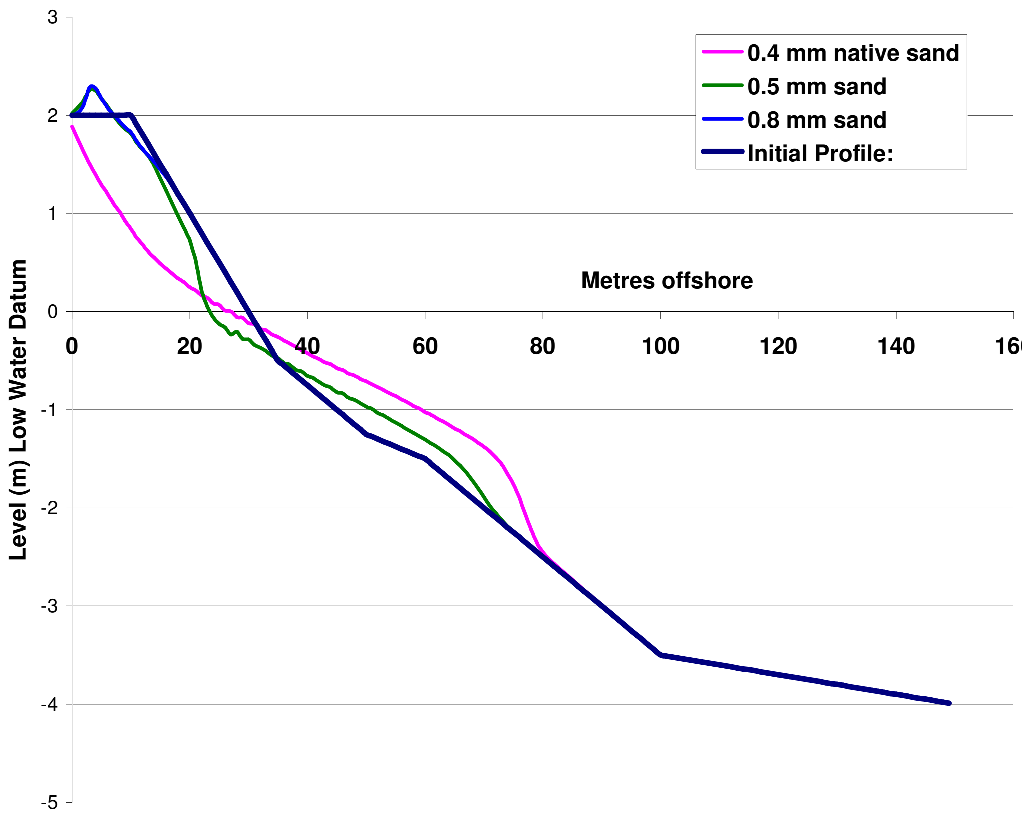

Figure 5.1: Beach profiles following design storms

It can be seen that there would be more offshore sand movement if medium grain sized sand (0.4mm) were used to nourish the beach. Sand that is washed offshore into water depths of greater than 2 metres is unlikely to be returned to the beach by ambient wave action. That means the sand is lost from the beach permanently.

Erosion, by offshore sand movement, for the medium coarse sand (0.5mm) is significantly less, and it is likely that all of the sand can be returned to the beach by ambient waves. Finally, there would be negligible offshore movement of coarse sand with a size of 0.8mm.

However, the medium-coarse and the coarse sand would still be moved to the east by longshore drift and lost from the western part of Shelley Beach. Therefore is suggested that beach nourishment should not be undertaken without some additional method of preventing the sand from moving to the east.

The most obvious potential sand sources for nourishment are:

- The accreted beach area along the eastern portion of Shelley Beach – the sand size is medium grained and offshore sand losses on the nourished beach could be significant during severe storms. Since there is an abundance of sand on the eastern portion of Shelley Beach, utilising this sand for beach nourishment could be cost effective for the short term, particularly if coupled with a sand retention structure (see Section 5.7);
- South Channel when either maintenance or capital dredging takes place. The area where sand waves occur tends contains some medium-coarse sand. Selective extraction of sand from this source would provide suitable beach nourishment sand; and
- Symonds Channel Spoil Ground: Sand dredged from South Channel during maintenance dredging is usually dumped in the Symonds Channel Spoil Ground. Medium coarse sand could be re-cycled to Shelley Beach.

Since maintenance dredging has just been completed and capital dredging may be some time off, the only immediate source of sand would be from the Symonds Channel Spoil Ground. The sand could be dredged from there using a small hopper dredge such as the Pelican. This dredge was used to nourish Sandridge Beach in Port Melbourne about 3 years ago. The Pelican can pick the sand up at the spoil ground and then steam to within about 200 metres of the beach and then pump the sand on the beach. The estimated cost would be about $12 per cubic metre, plus dredge mobilisation if it is not already in the region. That is a total budget of at least $500,000 is necessary.

5.4 Wave Dissipating Wall

The existing vertical timber wall reflects wave energy and effectively the turbulence created by the reflected waves results in an increased capacity for sand to be moved away from the beach. The existing structures and the toe of the cliff could be protected against undermining by the construction of a sloped dissipative wall. Typically such sloped seawalls are constructed of rock. The size of individual rocks required to construct a wall that would withstand the 50 year return period storm is 0.5 tonne.

A problem with Shelley Beach from a construction viewpoint is that there is no vehicular access to the western end of the beach. Therefore construction materials have to either be manhandled on to the beach or delivered by barge. The cost of obtaining and delivering suitable rock by barge would be expensive. Consequently, an alternative form of wall is suggested. It is formed from hexagonal concrete units which are relatively light and this allows for alternative construction methods. This type of wall also tends to absorb wave energy more than does a rock wall. Figure 5.2 shows a seawall under construction on Boigu Island in Torres Strait – this type of wall was used because any rock would have had to be imported by barge.

Since the blocks are formed from concrete it would be possible to colour the concrete to roughly match that of the in-situ limestone cliffs.

Figure 5.2: Hexagonal block concrete seawall

The unit weight for the concrete blocks could be as low as 55kg and each block would have a length of 600mm and a diameter of 300mm. In order to prevent wave overtopping for the 50 year return period storm the height of the crest of the wall would need to be 3m (LWD).

To protect the eroding foreshore and cliffs at western Shelley Beach would require about 200 metres of seawall. If construction were carried out by a contractor who would fabricate the blocks in a casting yard in Sorrento and then barge the blocks to Shelley Beach with his equipment, the cost is estimated at $500,000 to $700,000.

5.5 Groyne

Groynes are usually rock structures placed approximately perpendicular to the beach. An alternative construction form, often used for trial groynes, is a sand filled geotextile sausage. See Figure 5.3. The possible advantages of using a geotextile groyne are:

- The geotextile tube is light weight and could easily be moved to Shelley Beach;
- A small pump is required to fill the tube;
- The tube is filled with sand from the beach; and
- If the groyne does not perform up to expectations, or in fact destabilises the beach, it can readily be removed by cutting it with a knife. The sand that was in the tube returns to the beach.

Figure 5.3: Example of Geotextile Groyne

The purpose of a groyne is to prevent sand moving along a beach past it. At Shelley Beach there has been a steady movement of sand from the western part of the beach to the eastern part of the beach. If a groyne were constructed somewhere just to the east of Campbells Road, this west to east movement of sand could be interrupted.

At present a groyne on its own would not achieve anything because there is very little sand on the beach to the west of Campbells Road. Combined with beach nourishment, a groyne would assist to stabilise the beach (See Section 5.6). The groyne would need to be quite long because of the natural extent of sand movement and the shallow bank offshore from the beach. A short groyne would achieve little. The minimum groyne length would be about 80 metres. A possible groyne design concept is discussed further in Section 5.6 where a groyne would be combined with beach nourishment.

5.6 Offshore Breakwater

The deeper water off the western section of Shelley Beach allows larger waves to reach the shoreline than at the eastern part of the beach. Beach erosion is a function of the size of the waves striking the beach. The wave height could be reduced by constructing an offshore breakwater, parallel to the shoreline, that intercepts the waves. The offshore breakwater could be partially submerged, allowing some wave energy to pass over or it could be a complete obstacle.

A recently constructed offshore breakwater is at Glenelg (Adelaide) as shown in Figure 5.4. This breakwater is overtopped during storms occurring near high water.

An offshore breakwater would prevent losses of sand in a seaward direction and allow the western beach to grow seaward. The water would become considerably shallower than now and may impact on the boating usage of the area.

The beach would accrete because sand that is transported into the lee of the breakwater during the summer cannot readily be reached by waves from the north to north-western quarter because the breakwater intercepts these waves. This means that sand from the eastern portion of Shelley Beach would be redistributed naturally by the summer wave climate to create the beach in the western section. Figure 5.4 illustrates the likely beach scenario for an offshore breakwater.

An offshore breakwater would need to be constructed using imported (barged) rock and marine equipment. Construction costs are unlikely to be less than $1 million.

Figure 5.3: Glenelg offshore breakwater

5.7 Combinations of Options

Whilst a groyne on its own will not improve the beach, the construction of a groyne coupled with beach nourishment is an option. The groyne would then prevent the sand placed on the western beach from migrating to the eastern beach. Figure 5.5 illustrates the concept.

The following features are shown on Figure 5.5:

- The beach contained by the groyne will rotate between summer and winter: Clockwise in Summer and anti-clockwise in winter. Sufficient sand needs to be placed on the beach to ensure that a beach remains in front of the boatsheds at all times. A minimum of 40,000 cubic metres is required.
- This minimum quantity could be reduced if the groyne is constructed towards the end of summer. At this time the amount of sand on the western end of the beach will have been maximised and the beach may be expected to look something like the beach shown in Figure 2.3.
- The long groyne is required to prevent sand during winter from passing around the seaward end of the groyne. It is estimated that the groyne needs to be >80 metres long.

Figure 5.4: Offshore breakwater and accreted beach

Figure 5.5: Groyne with beach nourishment

- The beach to the east of the groyne will respond differently to that at present because of the presence of the groyne. During winter there will tend to be a seasonal loss of sand adjacent to the eastern side of the groyne. The length of the groyne needs to extend landward to prevent water passing behind the groyne. This leads to a total groyne length of at least 100 metres.
- In summer time the beach against the eastern side of groyne will be wider than it is at present.

The construction of the groyne will require rock and equipment to barged into Shelley Beach. A groyne of comparative proportions was constructed at Rye Front Beach in 1998 for about $130.000 using materials supplied by land. It is anticipated that construction of a groyne at Shelley Beach would cost in the range of $300,000 to $500,000 allowing for mobilisation costs and inflation.

A geotextile groyne should be considerably less expensive. It is anticipated that the construction of a geotextile groyne and moving 20,000 to 40,000 cubic metres of sand from the eastern part of Shelley Beach to the western part of the beach could be accomplished for $500,000.